

California Environmental Protection Agency

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**Portable Outboard Marine Tank Test Procedure**

**TP-512**

**Permeation Rate from  
Portable Outboard Marine Tank Fuel Hose Assemblies**

**DRAFT**

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***DRAFT***

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**California Environmental Protection Agency  
Air Resources Board**

**DRAFT TP-512**

**Permeation Rate from Portable Outboard Marine Tank  
Fuel Hose Assemblies**

The definitions in Section 2468.1, Article 6, Chapter 9 of Title 13, California Code of Regulations (CCR) apply to this test procedure.

For the purpose of this procedure, the term "ARB" refers to the California Air Resources Board, and the term "Executive Officer" refers to the ARB Executive Officer or his or her authorized representative or designate.

**1. APPLICABILITY**

This test procedure is used by the ARB to determine the permeation rate from a portable outboard marine tank fuel hose assembly as required in Certification Procedure CP-510. This test procedure is applicable in all cases where portable outboard marine tank fuel hose assemblies are subject to the maximum allowable permeation rates for portable outboard marine tank fuel hose assemblies that are manufactured for sale, advertised for sale, sold, or offered for sale in California or that are introduced, delivered or imported into California for introduction into commerce.

**1.1 Requirement to Comply with Other Applicable Codes and Regulations**

Certification or approval by the Executive Officer does not exempt a portable outboard marine tank fuel hose assembly from compliance with other applicable codes and regulations such as local, State or federal safety codes and regulations.

**1.2 Safety**

This test procedure involves the use of flammable materials and operations and should only be used by or under the supervision of those familiar and experienced in the use of such materials and operations. Appropriate safety precautions should be observed at all times while performing this test procedure.

**2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE**

Permeation emissions occur as fuel penetrates the molecular properties of a material and migrates to ambient air. The resulting emissions can be observed by measuring daily weight losses. This procedure gravimetrically measures permeation emissions over a period of 15 days.

### **3. BIASES AND INTERFERENCES**

- 3.1** Moisture, temperature and pressure can bias mass measurements. All data shall be recorded on the data sheet.
- 3.2** Samples stored near high concentrations of hydrocarbon vapor may gain weight. Care shall be taken to purge the temperature enclosure at regular intervals to limit hydrocarbon vapor buildup.
- 3.3** Incorrectly installed components may bias the reported results.
- 3.4** Some electronic balances are sensitive to the effects of small static charges. If small amounts of static electricity influence the balance, the portable outboard marine tank fuel hose assembly shall be statically discharged or the balance shall be shielded from the effects of static electricity.

### **4. SENSITIVITY AND RANGE**

The range of measurements is approximately 200 to 3,000 grams depending on the capacity and installed components. All measurements shall be conducted using an electronic top loading balance. The balance shall be capable of a maximum measurement of no less than 125% of the highest test weight. The balance shall have minimum readability of 0.01 grams and minimum reproducibility of  $\pm 0.02$  grams.

### **5. EQUIPMENT**

- 5.1** An electronic top loading balance that meets the requirements of Section 4.
- 5.2** NIST or NVLAP traceable calibration weights. A sufficient number of weights to verify measurements at 80%, 100%, and 120% of the test weight.
- 5.3** A ventilated, temperature enclosure capable of maintaining temperature between 69.5°F and 76.5°F.
- 5.4** Temperature instrument(s) capable of measuring air temperature to within  $\pm 2^\circ\text{F}$  of the temperatures in Section 5.3.
- 5.5** A barometric pressure instrument capable of measuring atmospheric pressure at the location of the balance to within  $\pm 0.02$  inches of mercury.
- 5.6** A relative humidity instrument capable of measuring relative humidity percentage (%RH) at the location of the balance with a sensitivity of  $\pm 2\% \text{RH}$ .
- 5.7** Phase II California Reformulated Certification (CERT), CE-10, E-10 (90% US E.P.A. Certification fuel, 10% Ethanol), CM-15, or Indolene test fuel.

## **6. CALIBRATION PROCEDURE**

- 6.1** All instruments and equipment used to conduct this procedure shall be calibrated per the manufacturer's specifications before testing.
- 6.2** The electronic balance shall be calibrated by a certified calibration company or agency within 12 months of testing.
- 6.3** During testing, the accuracy of the balance shall be verified with calibration weights at 80%, 100%, and 120% of the test weight before and after each set of test weighings. All verification readings shall be within  $\pm 2\%$  of the calibration weight mass. During test weighings, no more than 25 measurements or 2 hours shall pass (whichever is earliest) without verifying the accuracy of the balance. Tare the balance and repeat the previous measurement if the zero reading drifts more than  $\pm 0.01$  grams.

## **7. TEST PROCEDURES**

This procedure shall be used to calculate the maximum daily weight loss in order to demonstrate compliance with the maximum allowable performance standards for portable outboard marine tank fuel hose assemblies specified in CP-510.

- 7.1** Identify the assembly with a unique ID number and record the information on the data sheet (see Figure 1).
- 7.2** Determine the inside surface area of the fuel hose and primer bulb to the nearest square centimeter and record on the data sheet. (Impermeable components such as engine connectors, outboard motor tank connectors, and hose nipples are excluded.)
- 7.3** Check the balance with calibration weights at 80%, 100% and 120% of the test weight (see Section 5.2). Weigh the assembly (empty) and record on the data sheet. Confirm the balance has not deviated. Check the balance with calibration weights at 80%, 100% and 120% of the test weight.
- 7.4** Care must be taken to avoid temperature bias. Allow the certification fuel and assembly to acclimate to test temperature for a minimum of 6 to a maximum of 36 hours. After the acclimation period at no time during the test periods shall the certification fuel or assembly be removed from the test temperature for more than 30 minutes or Section 7.4 shall be repeated.
- 7.5** Fill the assembly with certification fuel described in Section 5.7. Ensure no vapor space remains. At no time during the remainder of testing shall the assembly be emptied of certification fuel.

- 7.6** Check the balance with calibration weights at 80%, 100% and 120% of the test weight. See Section 5.2.
- 7.7** Carefully weigh the assembly and record the initial test weight, date and time, temperature, relative humidity (%), and barometric pressure.
- 7.8** Confirm the balance has not deviated. Check the balance with calibration weights at 80%, 100% and 120% of the test weight. See Section 5.2.
- 7.9** Return the assembly to test temperature within 30 minutes of weighing.
- 7.10** After 24 hours (+/-30 minutes), check the balance with calibration weights at 80%, 100% and 120% of the test weight. Weigh and record the final weight of the assembly. Calculate and record the difference between the initial and final weights.
- 7.11** Repeat Sections 7.5 through 7.9 to refill the assembly and prepare for the subsequent day of testing. Ensure that the assembly and certification fuel are returned to test temperature within 30 minutes of weighing or filling.
- 7.12** Repeat Sections 7.10 through 7.11 for a minimum of 15 days or until a constant weight loss has been achieved, whichever is later. Constant weight loss is defined as the results of ten consecutive readings with a correlation coefficient of 95% or greater. See Section 8.
- 7.13** Record the highest daily weight loss on the data sheet. Refer to CP-510 for compliance with the maximum allowable permeation rate standard.

## **8. CALCULATING RESULTS**

### **Inside Surface Area**

The inside surface area of the fuel hose and primer bulb shall be converted to square meters as follows:

$$A_m = A_{cm} / 10,000$$

Where:

|          |   |   |
|----------|---|---|
| $A_m$    | = | inside surface area (square meters)               |
| $A_{cm}$ | = | measured inside surface area (square centimeters) |
| 10,000   | = | number of square centimeters per square meter     |

### **Daily Weight Loss**

The daily weight loss is calculated by subtracting the final weight from the initial weight:

$$W_{loss} = W_i - W_f$$

Where:

- $W_{loss}$  = daily weight loss (grams/day)
- $W_i$  = initial measured weight (grams) in a 24-hour period
- $W_f$  = final measured weight (grams) for the same 24-hour period

### Permeation Rate

$$P = W_{loss} / A_m$$

Where:

- $P$  = permeation rate (grams/day/square meters)
- $W_{loss}$  = daily weight loss (grams/day)
- $A_m$  = inside surface area (square meters)

### Constant Weight Loss Correlation Coefficient

Plot the cumulative daily weight loss (grams) against the sampling time (days). Perform a linear regression of ten (10) consecutive data points (spreadsheet or hand calculation) using the equation shown below. A correlation coefficient of 95% or greater shall demonstrate constant weight loss.

$$r = \frac{n(\sum XY) - (\sum X)(\sum Y)}{\sqrt{[n\sum X^2 - (\sum X)^2][n\sum Y^2 - (\sum Y)^2]}}$$

Where:

- $r$  = correlation coefficient
- $n$  = number of samples (10)
- $X$  = day number (i.e., 1-10)
- $Y$  = cumulative daily weight loss (grams)

## **9. RECORDING DATA**

Record all required data on a field data sheet. An example of a field data sheet is shown in Figure 1. Alternate test forms may be used provided they list the same minimum parameters as shown in Figure 1.

## **10. QUALITY ASSURANCE / QUALITY CONTROL**

All certified fuel specifications and data accuracy verifications including, but not limited to, annual calibrations and daily calibration checks shall be submitted with the test data when requesting ARB certification. All data must be carefully recorded on the field data sheet during the test. Any unusual occurrences in the process operation, unusual test instrument readings, or items that could possibly affect the test results should be noted on the data sheet. It is recommended that a checklist, in addition to the data sheet be used to assure all data needed for calculation or process information are obtained.

## **11. ALTERNATIVE TEST PROCEDURES**

Test procedures, other than specified above, shall only be used if prior written approval is obtained from the Executive Officer. In order to secure the Executive Officer's approval of an alternative test procedure, the applicant is responsible for demonstrating, to the Executive Officer's satisfaction, that the alternative test procedure is equivalent to this test procedure.

- (1) Such approval shall be granted on a case-by-case basis only and ARB approvals submitted with the affected test data.
- (2) Documentation of any such requests, equivalency demonstrations, and ARB approvals shall be maintained by the ARB and shall be made available upon request.

## **12. REFERENCES**

Phase II California Reformulated Certification (CERT) fuel as described in Part II, Section 100.3.1 of the Air Resources Board "California Exhaust Emissions Standards and Test Procedures for 2001 and Subsequent Model Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles," adopted August 5, 1999.

Society of Automotive Engineers (SAE), "Surface Vehicle Standard J1527 Marine Fuel Hoses", March 1, 2004 revision



### Figure 1 – Sample Data Sheet

Test Company: \_\_\_\_\_ Test Personnel: \_\_\_\_\_  
 Sample ID #: \_\_\_\_\_ Assembly Manufacturer: \_\_\_\_\_  
 Fuel Hose Class: \_\_\_\_\_ Fuel Hose Internal Diameter: \_\_\_\_\_  
 Assembly Weight (dry): \_\_\_\_\_ Assembly Length: \_\_\_\_\_ Inside Surface Area: \_\_\_\_\_  
 Hose Connector Model(s): \_\_\_\_\_ Primer Bulb Model: \_\_\_\_\_  
 Balance Make/Model: \_\_\_\_\_ Capacity/Resolution: \_\_\_\_\_ Annual Calib. Date: \_\_\_\_\_

#### Test Start:

Test Fuel Type: \_\_\_\_\_ Test Fuel Weight: \_\_\_\_\_  
 Test Start, Date/Time: \_\_\_\_\_ Test End, Date/Time: \_\_\_\_\_

#### Fuel Hose Assembly Permeation Results: (attach additional sheets for 15 or more test days)

Highest Daily Weight Loss: \_\_\_\_\_ (grams/day) Permeation Rate: \_\_\_\_\_ (grams/day/sq. meter)

| Day | Weight  |       |       | Temp. | % R.H. | Baro. | Pre Run Calibration Check |      |      | Post Run Calibration Check |      |      |
|-----|---------|-------|-------|-------|--------|-------|---------------------------|------|------|----------------------------|------|------|
|     | Initial | Final | Loss  |       |        |       | 80%                       | 100% | 120% | 80%                        | 100% | 120% |
| 0   |         | ----- | ----- |       |        |       |                           |      |      |                            |      |      |
| 1   |         |       |       |       |        |       |                           |      |      |                            |      |      |
| 2   |         |       |       |       |        |       |                           |      |      |                            |      |      |
| 3   |         |       |       |       |        |       |                           |      |      |                            |      |      |
| 4   |         |       |       |       |        |       |                           |      |      |                            |      |      |
| 5   |         |       |       |       |        |       |                           |      |      |                            |      |      |
| 6   |         |       |       |       |        |       |                           |      |      |                            |      |      |
| 7   |         |       |       |       |        |       |                           |      |      |                            |      |      |
| 8   |         |       |       |       |        |       |                           |      |      |                            |      |      |
| 9   |         |       |       |       |        |       |                           |      |      |                            |      |      |
| 10  |         |       |       |       |        |       |                           |      |      |                            |      |      |
| 11  |         |       |       |       |        |       |                           |      |      |                            |      |      |
| 12  |         |       |       |       |        |       |                           |      |      |                            |      |      |
| 13  |         |       |       |       |        |       |                           |      |      |                            |      |      |
| 14  |         |       |       |       |        |       |                           |      |      |                            |      |      |
| 15  | -----   |       |       |       |        |       |                           |      |      |                            |      |      |

#### Documentation of Performance (attach additional sheets as necessary)

Date: \_\_\_\_\_ Comment: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

